

REMARKS

Applicants have carefully considered the October 18, 2004 Office Action, and the amendments above together with the comments that follow are presented in a bona fide effort to address all issues raised in that Action and thereby place this case in condition for allowance. Claims 1-28 are pending in this application. In response to the Office Action dated October 18, 2004, claims 4 and 24 have been amended. Care has been exercised to avoid the introduction of new matter. Adequate descriptive support for the present Amendment should be apparent throughout the originally filed disclosure as, for example, the depicted embodiments and related discussion thereof in the written description of the specification. Applicants submit that the present Amendment does not generate any new matter issue. Entry of the present Amendment is respectfully solicited. It is believed that this response places this case in condition for allowance. Hence, prompt favorable reconsideration of this case is solicited.

Claim 28 was rejected under 35 U.S.C. § 112, second paragraph. Applicants respectfully traverse. The dependency of claim 28 has been amended such that claim 28 depends from claim 22 and now provides antecedent support for the claim term "second impurity". Accordingly, one having ordinary skill in the art would not have difficulty understanding the scope of the presently claimed invention, particularly when reasonably interpreted in light of the supporting specification. Therefore, it is respectfully submitted that the imposed rejection of claim 28 under 35 U.S.C. § 112, second paragraph is not legally viable and hence, solicit withdrawal thereof.

It is noted that claim 4 was amended to provide antecedent support for the term "punch-through region" in the last three lines of claim 4. Entry of the amendment to claim 4 is respectfully solicited.

Claims 1-27 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Yamamoto et al. (U.S. Pat. No. 6,737,722, hereinafter “Yamamoto”). Applicants respectfully traverse.

Claim 1 describes, *inter alia*, that the free carrier density of the base region, where no depletion layer is formed, is smaller than the space charge density of a depletion layer formed in the base region. Claim 4 describes, *inter alia*, the free carrier density of the punch-through stop region, where no depletion layer is formed, is smaller than the space charge density of a depletion layer formed in the punch-through stop region. Applicants submit that Yamamoto fails to disclose or suggest these claim features of independent claims 1 and 4. Moreover, for the reasons outlined below, Applicants submit that Yamamoto discloses a carrier concentration of a graded base, which is unrelated to the present claimed subject matter.

Practically, the carrier density of a base region should be: (1) small for a desirable current gain; (2) large for a desirable withstand voltage of punch-through region; and (3) smaller than a specified limit for a required withstand voltage of drift region. In the existing prior art, a problematic trade-off exists depending on a carrier density in a base region, which is required to concurrently serve as a drift region (for a depletion layer to extend therein, with a developed potential distribution that holds a voltage) responsible for withstand voltage; and a punch-through stop region for prevention of punch-through between a source region and a drain region. Yamamoto is bound to the condition of limit (3) above, where the carrier density of base region is kept from uniform increase, and employs a serial formation of a graded base with a distributed (stepwise) carrier density in an attempt to improve performance. Yamamoto discloses a plurality of sub-regions each having a fixed carrier density and is subject to the trade-off between current gain and withstand voltage, thus resulting in an unavoidable reduction in performance of current

gain, while the degree of reduction may be moderated by addition of a “graded base” (i.e. a sub-region high of carrier density).

In contrast, the present claimed subject matter is substantially free from the trade-off described above. As illustrated in Fig. 1 (basic model), the base region to be uniform in impurity density is formed with impurity materials greatly different in space charge density and carrier density, which allows the carrier density to be controlled in accordance with an imposed voltage. More specifically, in a forward-biased state for a bipolar transistor to turn on, the base region is adapted to work with a carrier density smaller (by approximately two orders of magnitude) than an associated space charge density. Further, in a reverse-biased state for the bipolar transistor to turn off, the base region is adapted to have a depleted sub-region excited for an increase in carrier density to achieve an equivalent density (such that a space charge density is higher by approximately two orders of magnitude).

Accordingly, with the present claimed subject matter, the carrier density of base region is controllable in accordance with an imposed voltage, allowing for improvements of both current gain and withstand voltage and meeting the conditions (1) and (2). In other words, with the present claimed subject matter, the semi-conductive material is combined with impurity materials so as to provide a difference between space charge density and carrier density, giving rise to the controllability of carrier density in base region, thereby eliminating the trade-off between current gain and withstand voltage, which exists in the applied prior art.

Based upon the foregoing, Applicants submit that the Examiner has not established a prima facie basis to deny patentability to the claimed inventions under 35 U.S.C. § 103 for the reasons set forth *supra*. As such, the rejection should be withdrawn. With respect to independent claim 8, it is noted that the Examiner failed to address the limitations recited in

claim 8. Applicants submit that claim 8 is allowable over the cited art. If the Examiner maintains the rejection of claim 8, Applicants respectfully request that the Examiner address claim 8 such that Applicants are afforded the opportunity to respond to any specific rejection and or objection.

It is believed that pending claims 1-28 are now in condition for allowance. Applicants therefore respectfully request an early and favorable reconsideration and allowance of this application. If there are any outstanding issues which might be resolved by an interview or an Examiner's amendment, the Examiner is invited to call Applicants' representative at the telephone number shown below.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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